

LAWN MOWER CHUTE OPENING APPARATUS AND METHOD

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Cross Reference to a Related Application

This application claims the benefit of U.S. Provisional Patent Application Serial No. 60/421,460 filed October 25, 2002.

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Field of the Invention

The subject invention pertains generally to lawn mower apparatus, and in particular relates to an apparatus and a technique for quickly opening a lawn mower chute.

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Background of the Invention

Power operated lawn mowers typically have a shroud with depending sides that extend over and surround the rotating cutter blades within the shroud. Typically, the shroud is fitted with a discharge chute through which the cut grass exits to be either passed to a collection container for later disposal, or is deposited on the lawn in the form of mulch. In certain areas, however, it is imprudent to leave the discharge chute open; such situations exist when the lawn mower is being used near buildings or around people, as small stones or other dangerous objects may be discharged at a relatively high

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velocity, causing damage or injury.

To counter this problem, the prior art has developed a number of techniques for permitting the discharge chute to be alternately opened and closed in a relatively rapid
5 manner. Examples of such prior art arrangements are disclosed below. As more fully explained herein, these arrangements suffer from various drawbacks.

U.S. Patent No. 4,135,351 to Akgulian discloses a rotary lawnmower grass mulcher assembly having a mower
10 housing and a discharge opening covered by a pair of plates having air holes there through. The air holes are offset between the two plates, which allows for the discharge of air while maintaining the grass clippings in the mower housing for mulching.

15 U.S. Patent No. 4,45,312 to Cartner discloses a mower head with movable guard for an articulated boom assembly attached to a mow tractor. The movable guard may be opened via a hydraulic means for allowing the mower blade to cut saplings and the like.

20 U.S. Patent No. 5,040,364 to Deegan discloses a lawnmower having a selectable discharges means. The lawnmower described comprises a cutting deck having a plurality of discharge exit ports, each covered with a closure means. Each closure means is connected to a
25 control lever, which operates to open and close the closure

means via a cable attachment.

U.S. Patent No. 5,048,279 to Badawey et al. discloses a leaf mulcher for use with a rotary blade power lawnmower.

The leaf mulcher comprises a screen, which covers the
5 outlet of the lawnmower. The screen is offset to provide a space between the outlet and the screen thereby allowing a portion of the grass clippings to escape from outlet without passing through the screen.

U.S. Patent No. 5,133,175 to Dumbrell discloses a
10 safety flap for power-operated lawnmower the apparatus remains in the closed position due to the force of gravity.

U.S. Patent No. 5,284,007 to Poe et al. discloses a mulching and shredding attachment for the use on a lawnmower or lawn vacuum, which is held in place by a
15 bracket comprising a lever and a clevis pin. Removal of the pin allows for the apparatus to be engaged or disengaged.

U.S. Patent No. 5,657,620 to Thagard et al. discloses a device for mowing, cutting and mulching. The device is
20 generally attached to a tractor power drive, and comprises a shroud mechanism that may be mechanically opened. When the shroud mechanism is mechanically opened it exposes the cutting means for removing brush and saplings.

Finally, U.S. Patent No. 5,826,417 to Evans discloses
25 an operator control deflector plate for the discharge chute

of a riding lawnmower. The deflector plate comprises a series of air holes large enough to allow the passage of grass, however, small enough to prevent the passage of objects sufficient to cause physical injury or property damage. The device may be selectively opened by a lever mechanism mounted to the lawnmower cutting deck.

Despite these prior art efforts, there remains a need for discharge chute opening and closing apparatus that is rugged and operates to quickly move the cover for the discharge chute between the open and closed positions. All documents and publications cited are incorporated by reference to the extent not inconsistent with the explicit teachings set forth herein.

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Brief Summary of the Invention

It is an object of the present invention to provide a discharge chute opening and closing apparatus for lawn mowers that is rugged, reliable and operates to quickly open and close the discharge chute.

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The discharge chute opening and closing apparatus for lawn mowers comprises, in combination, the following: a vertical bar fixedly attached to a pivot bar, rotatably mounted between first and second pivot stanchions; a pivot arm fixedly attached to said pivot arm at a first end and engaged with a cam pin at a second

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end; a cam plate comprising a cam pin and a drive pin rotatably attached to a third pivot stanchion; a lift plate rotatably attached to the third pivot stanchion and fixedly attached to a chute cover being operably engaged
5 by the cam and drive pins; a second lift plate fixedly attached to a fourth pivot stanchion further comprising a spring attachment; a spring attached at a first end to the spring attachment of the lift plate and attached at a second end to a spring mounting bracket wherein the
10 spring assists in maintaining the position of the chute cover.

The vertical bar has a first end defining a handle and a second end fixedly attached to a pivot bar for translating torque from the operator to the pivot bar.
15 When engaged by the user, the handle operates to open and close the chute cover. The pivot bar is rotatably disposed between a first pivot stanchion and a second pivot stanchion and is further attached to a generally horizontal pivot arm. Movement of the vertical handle
20 translates to movement of the pivot arm.

The horizontal pivot arm has a first end attached to the pivot bar and a second end comprising a crank plate.

The crank plate further defines an aperture that receives a first end of a cam pin. Movement of the
25 pivot arm translates torque to the cam pin, which is

fixedly attached through and causes rotation of a cam plate. The cam plate is rotatably attached to a third pivot stanchion and comprises a cam pin and a drive pin. As the cam plate is rotated about its axis, a second end
5 of the cam pin engages and raises a first lift plate attached to the chute cover door.

The chute cover door fixedly attached to the first lift plate and a second lift plate wherein the second lift plate is rotatably attached to a fourth pivot
10 stanchion. When closed, the chute cover door is generally in a substantially vertical position. When opened, the chute cover door is opened past the horizontal position to allow for the unimpeded discharge of grass clippings.

15 The opposite movement of the handle generally closes the apparatus. The pivot arm essentially pushes down on the cam pin and the cam plate is rotated in an opposite direction. As the cam plate rotates the drive pin engages the lift plate and pushes the lift plate forward
20 wherein gravity or an attached spring operates to complete the closing process.

By way of example, the apparatus may further comprise a spring attached between the second lift plate and a spring mount to facilitate the opening of the chute
25 door. The spring can be mounted to provide constant

tension between the lift plate attached to the chute door and the spring mount attached to the cutting deck. When the apparatus closed, the spring can operate to maintain the chute cover in the closed position. When the chute
5 cover apparatus is opened, the spring can operate to maintain the chute cover in the open position.

The apparatus may include a staybar that allows for the partial opening of the apparatus when in operation. The staybar can be attached to a lift plate and provide
10 structural support therefore. The staybar can comprise a design having an offset center of gravity that allows the staybar to maintain an upright position as the apparatus is opened slowly. The staybar can maintain this upright position until the chute cover reaches a critical angle,
15 then the staybar will rotate allowing for the chute cover to fully close. Such a feature is particularly helpful when a partial discharge of grass clippings is desired.

In a further embodiment the apparatus can comprise a stop bolt attached to an end of the pivot arm to prevent
20 the pivot arm from over rotating and becoming disengaged from the cam pin.

In another embodiment a limiting means may be installed to prevent the chute cover from over rotating and causing damage to the components. In a preferred
25 embodiment the limiting means comprises a shock pad made

from a resilient material such as rubber, nylon, plastic or the like for eliminating or reducing the wear caused by two metal parts coming into abrupt contact with one another.

Further objects and advantages of the present invention will become apparent by reference to the following detailed disclosure of the invention and appended drawing wherein like reference numbers refer to the same feature, component, or element.

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Brief Description of the Drawings

FIG. 1 is a top plan view of the discharge chute opening and closing apparatus according to the present invention, fitted to the shroud of a lawn mower;

FIG. 2 is a rear perspective view of the apparatus shown in accordance with the present invention.

FIG. 3 is a side perspective view of the apparatus according to the present invention, with the chute cover removed.

FIG. 4 is a side plan view of a pivot upright assembly of the present invention.

FIG. 5 is a front plan view of a pivot upright assembly of the present invention.

FIG. 6 is a side fragmentary view of the chute cover assembly of the present invention.

FIG. 7 is a side plan view of the staybar of the present invention.

FIG. 8 is a front sectional view of the staybar/lift plate assembly of the present invention.

5 **FIG. 9** is a side fragmentary view illustrating a one-quarter opened chute cover assembly.

FIG. 10 is a side fragmentary view illustrating a half opened chute cover assembly.

10 **FIG. 11** is a side fragmentary view illustrating a fully opened chute cover assembly.

FIG. 12 is a side fragmentary view illustrating a one-quarter closed chute cover assembly.

15 **FIG. 13A** is a side fragmentary view of the cam plate/lift plate assembly of the present invention in the closed position.

FIG. 13B is a front fragmentary view of the pivot arm assembly of the present invention in the closed position.

20 **FIG. 14A** is a side fragmentary view of the cam plate/lift plate assembly of the present invention in the partially opened position.

FIG. 14B is a front fragmentary view of the pivot arm assembly of the present invention in the partially opened position.

FIG. 15A is a side fragmentary view of the cam

plate/lift plate assembly of the present invention in the partially opened position.

FIG. 15B is a front fragmentary view of the pivot arm assembly of the present invention in the fully opened position.

Detailed Description of the Invention

Referring now to **FIG. 1**, an opening and closing lawnmower chute cover apparatus is illustrated and generally designated by the reference numeral **10**.

The apparatus **10** is designed for use with a lawn mower having a shroud **12** with an upper, generally horizontal surface **11** and a generally vertical depending skirt **13**. The shroud **12** includes a chute opening **14** (shown by dotted line in **FIG. 1**) along a side **16** in the skirt **13**. The opening and closing apparatus **10** is fitted along an area **18** of the shroud upper surface **11** which extends generally parallel with the chute opening **14**.

The apparatus **10** is provided with a chute cover **20** which comprises a first chute cover portion **22** extending across and generally parallel with the area **18** and a second portion **24** extending generally vertically over the chute opening **14** and parallel with side **16**, when the chute cover **20** is in the closed position, as depicted in **FIG. 1**.

The apparatus 10 comprises a first plate 26 having opposing ends 28, 29, a second plate 30 having opposing ends 32, 34 and an extension plate 38 having opposing ends 40, 44. As depicted in the drawings, the first plate 26
5 lies along the upper shroud surface 11 in the area 18 generally parallel with the side 16, the second plate 30 lies generally perpendicular to the side 16 along the shroud surface 11 and the extension plate 38 is fitted at its first end 40 via fastener 42 to the second end 29 of
10 plate 26, with the second end 44 of extension plate 38 extending angularly away from the side 16 along shroud surface 11. It will of course be understood by those skilled in the art that the plates 26, 30 and 38 may be formed of a unitary plate member. The plates 26, 30 and 38
15 are attached to the shroud 12 via fasteners, such as fasteners 36 and 42.

In accordance with the present invention, the apparatus 10 comprises at least four pivot uprights 46, 48, 50 and 52. The first pivot upright 46 is fixed to and
20 extends generally vertically from the proximal end 32 of the second plate 30 and the second pivot upright 48 is fixed to and extends generally vertically from the second end 34 of the second plate 30. The third vertical upright

50 is attached along the second plate 30 in spaced relation to the first upright 46, and rearwardly with respect to the side 16 of shroud 12, as shown in FIG. 1. The fourth pivot upright 52 is attached to the distal end 44 of the extension plate 38.

Referring next to FIGS. 4 and 5, with specific reference to pivot upright 50, each pivot upright 46, 48, 50 and 52 includes a stanchion 54 atop which is affixed a bearing support member 56 into which is fitted a generally circular bearing 58 with a central bore 60. It will be understood by those skilled in the art that the construction details of the pivot uprights 46, 48, 50 and 52 are all identical to that shown specifically with reference to pivot upright 50 in FIGS. 2 and 3. Each of which is adapted to rotatably support a cylindrical shaft that is rotatable about a central axis 62 extending through the opening 60 in the corresponding pivot upright.

Referring again to FIG. 1, the pivot uprights, 46, 48 fixed to the opposing ends of plate 30 rotatably support a main pivot bar 64 having a first end 66 which is pivotally secured with the first pivot upright 46 and a second, distal end 68 which is pivotally secured with the second pivot upright 48, so that the main pivot bar 64 is

rotatably suspended between uprights **46** and **48** above the surface of the plate **30**. The positioning of the main pivot bar **64** is maintained at the respective ends **66** and **68** thereof via lock nuts **70** (at end **66**) and bolt **72** welded to pivot arm **102** near end **104**, and lock nut **76** (at end **68**) and bolt **74** welded to pivot bar **64** at end **68**, together with corresponding threads on those ends. Similarly, as shown on the right side of **FIG. 1**, pivot upright **50** has associated lock nuts **78**, **80** pivotally supporting pivot rod **82**, and pivot upright **52** has associated lock nuts **84**, **86** which hold in place pivot rod **88**. Rods **82** and **88** together with associated hardware are described in greater detail below.

Turning again to the construction details of the apparatus **10** associated with the second plate **30**, an upstanding bracket **90** is fixed to the upper surface of the second plate **30** and extends above the main pivot bar **64** so as to support a shock pad **92** above the main pivot bar **64**. As is evident from **FIG. 2**, the shock pad **92** supports the chute cover **20** by engaging the first portion **22** when the chute cover **20** is in an open position.

With continuing reference to **FIG. 1**, a brace **94** is fixed along the main pivot **64** and has a generally vertical handle **96** fixed thereto at a proximal, lower end **98** of the

handle. As will be appreciated by those skilled in the art, the upper, distal extremity **100** of the handle **96** can be used by an operator to effectuate a rotation of the main pivot bar **64**, which in turn effectuates rotation of pivot arm **102** about its proximal end **104** which is, in turn, fixed to the main pivot bar **64** in abutting relationship with bolt **72** associated with pivot upright **46**. At the same time, the opposing, distal end **106** of pivot arm **102** is rotated away from the area **18** of shroud surface **11**. A cam plate assembly including cam plate **112** and crank plate **108** are cooperatively attached with the distal end **106** of the pivot arm **102**, so as to effectuate the raising and lowering of lift plate **114**. Lift plate **114** is fixed at a first end **116** to the first portion **22** of chute cover **20**, and at the opposing end **118** is pivotally mounted along shaft **88** associated with pivot upright **52**. Therefore, when the upper extremity **100** of the handle **96** is moved in a direction generally parallel with the direction of the side **16** and chute opening **14**, the main pivot bar **64** is rotated in the manner described above so as to lift the distal end **106** of the pivot arm **102**, thereby effectuating the raising or lowering of the cover **20**. The cover **20** is shown in the closed position in **FIG. 1**; when raised to the open position, the first surface **22** of the cover **20** rests upon

the shock pad **92**.

Turning now to **FIGS. 6** and **3**, the apparatus **10** is shown in a closed position. As can be seen from **FIG. 6**, the spring **120** is attached at a first end **132** to an extension **147** of the pivot point **131** of the staybar **125** and at a second end **134** to the spring mounting bracket **122**. When in the closed position, the spring **120** operates under tension to pull the chute cover **20** closed, thus maintaining its position. This is caused by the spring **120** being attached to a point **133** on the lift plate **124** that is lower than the lift plate pivot point **135**. As the chute cover **20** begins to open, as depicted in **FIG. 9**, the spring **120** begins to stretch. As the chute cover **20** is opened further, as depicted in **FIG. 10**, the spring **120** is under its highest tension as the lift plate **124** passes the apex of the rotation about the lift plate pivot point **135**. As the pivot point **131** of the staybar **125** passes the apex of the lift plate **124** rotation, the spring **120**, under tension acts to now pull the chute cover **20** to an open position. At this point, the spring **120** operates to maintain the chute cover **20** in an open position, as depicted in **FIG. 11**.

The chute cover **20** will remain in the open position until such time as the handle **100** is moved in the opposite

direction to effectuate the closing of the chute cover **20**.

As is shown in **FIG. 11**, the first chute cover portion **22** comes to a rest at a shock pad **92** that operates to limit the rotation of the chute cover **20**. The shock pad is attached to an upstanding bracket **90** and can comprise a resilient material to reduce the amount of wear caused by abrupt metal-to-metal contact.

Referring next to **FIG. 7**, the staybar **125** comprises a lower end **129** and an upper end **127**. The pivot point **131** of the staybar **125** passes through the upper portion of the lower end **129**. Because of the configuration of the staybar **125**, its center of gravity **C** ensures that the staybar **125** maintains the appropriate of the chute cover **20**.

When the apparatus **10** is partially engaged by the operator, the position of the staybar **125** is changed and the staybar **125** moves from an angled resting position, as depicted in **FIG. 6**, to an upright position, wherein the lower end **129** of the staybar **125** is generally flat against the surface **11** of the second plate **30**. In this position the staybar **125**, through its connection **133** with the lift plate **124** maintains the chute cover **20** in a partially opened position.

To reset the staybar **125**, the chute cover **20** should be

fully opened. When the chute cover is **20** is sufficiently opened, the stop pin **136** engages the upper end **127** of the staybar **125** and rotates it in the same direction as the chute cover **20**. When the center of gravity **C** rotates over
5 and beyond the pivot point **131** of the staybar **125**, the upper end **127** of the staybar **125** rotates entirely over as a result of gravity. At this point, the staybar **125** is reset and when the operator closes the chute cover **20**, the chute cover **20** will close entirely.

10 Referring now to **FIG. 8**, the staybar **125** and lift plate **124** assembly is shown. Through the lift plate **124** and staybar **125** pivot point **131** passes a through bolt **139** held in place by a first lock nut **141**, spaced by washers **143** and secured by a pair of jam nuts **145A**, **145B**. The
15 through bolt **139** is extended beyond the jam nuts **145A**, **145B** and further comprises a spring attachment point **147** and a second lock nut **149**.

Turning next to **FIG. 9**, as the chute cover **20** is opening, the pivot arm **102** is activated by handle **96** that
20 actuates crank plate **108** by engaging the cam pin **110**, as depicted in **FIGS. 13A** and **13B**. At rest the pivot arm **102** is in a generally horizontal position. When rotated about the pivot arm axis **150**, the distal end **106** of the pivot arm **102**

is elevated. The crank plate **108** attached to the distal end **106** of the pivot arm **102** engages the cam pin **110** on a first side through the aperture **109**. As the pivot arm **102** is raised, the crank plate **108**, in combination with the cam pin **110**, operates to rotate the cam plate **112** about the cam plate pivot point **88**.

As the cam plate **112** rotates, a second end of the cam pin **110** engages the lift plate **114**, attached to the chute cover **20**, and causes the lift plate **114** to rotate about pivot rod **88**, as depicted in **FIGS. 14A** and **14B**. Once the actual centerline of the spring **120** passes above the center of pivot rod **88**, the tension of spring **120** continues the rotation of lift plate **114** until the chute cover **20** is completely open and contacts shock pad **92**. It will be understood by those skilled in the art that the pivot arm **102** moves the chute cover **20** only to a rotation position where the spring attachment **147** passes the apex of rotation the center line of the pivot rod **82**, and the spring **120** then completes the chute cover **20** opening process; otherwise, the chute cover **20** could only be fully opened as a result of the inertial moment of the chute cover rotation as a result of travel limitations of the pivot arm **102**.

It will be appreciated by those skilled in the art

that the over rotation of the pivot arm **102** will cause the cam pin **110** to exit the aperture **109** and disengage from the crank plate **108**. To limit rotation of the pivot arm **120**, stop bolts **155** may be attached the pivot arm **102**, thereby
5 decreasing the occurrence of detachment.

With continuing reference to **FIG. 9**, also note that when the chute **20** is partially open, the staybar **125** is rotated due to its offset center of gravity **C**. When the chute **20** is opened slowly, the staybar **125** rotates into the
10 position shown in **FIG. 9**, holding the chute cover **20** in a partially open position, permitting the vertical handle to be released while the staybar **125** is in this position.

Reference is now made to **FIG. 10**; as the chute is rotated by the handle **96** to the position shown, the center
15 line force of the spring has moved above the pivot point of the chute cover **20**, and spring tension completes the chute cover **20** opening, as described above, without force being exerted on the handle **96**. The position of the staybar **125** during that continued movement control is continued until
20 the chute cover **20** is fully opened, as shown in **FIG. 11**.

Next referring to **FIG. 12**, the closing operation of the apparatus **10** will now be described. The pivot arm **102**, when actuated by handle **96**, actuates crank plate **108** by engaging the cam pin **110** of cam plate **112**, causing

rotational movement of the cam plate **112** until the cam pin **130** contact lift plate **114** and rotates it about the center line of pivot point **88**, as depicted in **FIGS. 15A** and **15B**. Rotation continues until the centerline of the spring **120** passes below the apex of the rotation about the pivot point **82**; thereafter, spring tension continues the rotation of the lift plate **124** until the chute cover **20** is closed. As indicated in **FIG. 12**, the staybar **125** stays in the rotated position due to the inertia and the center of gravity **C** of the staybar **125**. It will be noted that in the closing operation, the pivot arm **102** has travel limitations and relies upon the tension of the spring **120** to complete the closing of the chute **20** (i.e., the center line of the spring **120** must pass below the center of pivot point **82** in order to complete the closing of the chute **20**).

Inasmuch as the preceding disclosure presents the best mode devised by the inventor for practicing the invention and is intended to enable one skilled in the pertinent art to carry it out, it is apparent that methods incorporating modifications and variations will be obvious to those skilled in the art. As such, it should not be construed to be limited thereby but should include such aforementioned obvious variations and be limited only by the spirit and scope of the following claims.